European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.2532778 Volume 5 | Issue 3 | 2019

EFFECTS OF A TRAINING PROGRAM BASED ON LONGITUDINAL TRAINING OF ATHLETE DEVELOPMENT (LTAD) APPROACH ON GROSS MOTOR SKILLS AMONG 6-8 YEARS OLD CHILDREN

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Abstract:
The aim of this study was to examine effects of a training program based on longitudinal training of athlete development approach on gross motor skills among 6-8 years old children. Participants of Multi Branches Talent Identification and Development Project (n = 54), Basketball School players (n = 55) and a control group (n = 50) participated in the study. Multi Branches group attended to training sessions lasted 90 minutes, three days in a week for six months. Test of Gross Motor Development-2 test was used to assess development of locomotor and object control skills of the three groups before and after 6-months training period. Wilcoxon test indicated that post-test scores of Test of Gross Motor Development-2 were significantly higher than pre-test scores for all three groups ($p<.001$). Kruskal Wallis test results showed that there were statistically significant differences between three groups on the object control and total scores of Test of Gross Motor Development-2 ($p<.001$) but no differences on the

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locomotor scores of the test. The development percentage of Multi Branches group was higher than those of the other two groups. As a result, it can be concluded that the training program based on Long Term Athlete Development approach improved object control skills of 6-8 years old children.

Keywords: test of gross motor development-2, multi branches talent identification, motor development

1. Introduction

The "talent" concept which is defined as the entirety of above-average anthropometric, motoric, physiological and psychological characteristics of children in their own age groups has been one of the important study titles formed by sports scientists and practitioners to raise elite athletes under the titles of "talent determination", "talent definition", "talent research", "talent development" and "talent selection" (Savelsberg et al., 2010; Morais et al., 2014; Muratli, 2007; Sevim, 2002).

Motor development is the gain of movement patterns and skills by the organism during a life-long process since birth as parallel to the physical growth and central nervous system development. During this process, many factors and the interactions of these factors with each other bring along growth, maturation and new motor experiences within the framework of nerve-muscle harmony (Mengutay, 2005; Ozer and Ozer, 2004; Gallahue, Ozmun and Goodway, 2012).

Motor skills encompass a process progressing from reflexes, movements related to stance, simple reflexes such as walking, running and jumping towards coordinated skills with the development of the nervous system and muscles as to be from head to toe and center to outward. This process which ensures the development of movement skills is the main purpose of motor development (Oberer et al., 2017; Mengutay, 2005; Gallahue, Ozmun and Goodway, 2012).

Test of Gross Motor Development-2 (TGMD-2) which is a measurement tool formed based on the dynamic system approach and with the process purpose, was developed by Ulrich (2000) to assess motor development of 3-10 age group children (Ulrich, 2000). This test has been shown as a valuable tool for the definition of motor delays and is the assessment of a child's skills to determine children who have mild, mediocre and severe defects and at the same time by applying 12 motor skills as an age and gender comparison (Gursel, 2014; Logan et al., 2014; Valentini, 2012). Furthermore, it is used as a measurement tool to assess personal progress in gross motor skill development, to assess program success and in research on development (Williams et al., 2009).

Long Term Athlete Development (LTAD) encompasses studies that need to be conducted in certain ages and stages in child development and its project was made in Canada. LTAD provides a tool for the development way and philosophy of athletes and participants and a cultural change in sports, and for the formation of a draft for

programs and play grading. Children are ensured to succeed in sports best by an active start, staying active and studies provided to children at the right time (Balyi and Hamilton, 2004).

Parents, who dream of an Olympic victory or wealth from professionalism for their children, think that the most important factor for basic success is early specialization and they place their children in programs oriented to specialization very early. Development of some athletes is unplanned and even accidental, and as creating "accidental champions", the development of the others occurs as planned, systematically, gradually and developmentally appropriately. This planned, systematic and gradual development of an athlete is called longitudinal athlete development (Balyi and Hamilton, 2004; Balyi et al., 2013).

It is thought that the project, which is implemented in various countries in the world and overlaps with the content of LTAD projects and is implemented in Turkey under the title of "the model of multi-branch talent identification and development", will contribute to the field at the point of raising right athletes at right branches owing to the obtained factual data (Bilge et al., 2010; Bilge et al., 2014).

This research was conducted to scrutinize the effect of the training programs, which were prepared in the project scope and overlap with the LTAD program framework and are implemented in Turkey under the title "the model of multi-branch talent identification and development", on the motor skill development of children in the 6-8 age-group.

2. Method

2.1. Participants

Participants were recruited by the scales of gross/fine motor, self-help and play/interaction skills (adapted from Folio and Fewell, 2002; Furuno, 1994; Gardner, 2003; Schafer et al., 1981).

Participants of the study consisted of three groups aged between 6-8 years old children. These groups are listed below:

a) Participants of the Project of Multi-branch Talent Identification and Development (MB): Children in this project attended to training sessions based on LTAD lasted 90 minutes, three days in a week for six months.
b) Basketball sport school players (BP): These children attended to regular basketball training sessions lasted 90 minutes, three days in a week.
c) Sedentary elementary school students (Control group-CG): This group consisted of the children who do not engage in sport or exercise regularly.

Characteristics of all three groups were presented in Table 1.

Table 1: Characteristics of the participants in groups

	MB	BP	CG
Age (M±Sd)	6.62 ± 0.84	8.71 ± 1.13	6.17± 0.66
Girls(n)	18	17	26
Boys(n)	36	38	24
Total (n)	54	55	50

This research was conducted in accordance with the ethics statement of the committee of Kirikkale University before participation (Decision No: 06/02, Date; 05/03/2015). Written parental permission was also provided for all of the volunteers.

2.2. Measures

2.2.1. TGMD-2 (Ulrich, 2000)

TGMD-2 was used to examine development of locomotor and object control skills of the three groups. The test consists of 12 gross motor skills divided into two subtests: a) Locomotor (running, galloping, leaping, jumping, hopping and sliding) 2) Object Control (ball skills such as kicking, striking, dribbling, catching, overhand throwing, and underhand Rolling (Ulrich, 2000; Haugen and Johansen, 2018).

The test lasts for 15-20 minutes for a child. The child has to repeat each movement twice. 1 point is given for a correct movement and 0 score is given for an incorrect movement. The total score of both movements makes up the score of that skill. Maximum score that can be received in both subtests is 48. The test results can be used for standard score formation and personal score comparison (Cools et al., 2009; Ulrich, 2000). The validity of TGMD-2 is higher than 0.96 and the relevance of the results is higher than 0.89 (Valentini, 2012).

The reliability studies conducted in Turkey; the internally consistent reliability coefficients for the locomotor subtest ranged from 0.79 to 0.90 and their average was 0.85. The object control coefficients ranged from 0.67 to 0.93 and their average was 0.78 (Cools et al., 2009).

Kerkez (2013) has found high reliability in TGMD-2 in Turkey. Considering the reliability criteria, the internal consistency for locomotor skills was 0.85 and the test – retest reliability was 0.88 and the consistency between the observers was 0.98. The internal consistency for object control skills was 0.88, the test-retest reliability was 0.93 and the consistency between the observers was 0.98. The internal consistency for the total TGMD-2 was 0.91, the test – retest reliability was 0.96 and the consistency between the observers was 0.98. The validity analyses made for the TGMD-2 showed that the TGMD-2 measured the large muscle skills validly and the researchers could use the TGMD-2 confidently.

2.3 Intervention

2.3.1. The Model of Multi-Branch Talent Identification and Development

A. MB (The training based on LTAD approach)

Since the schools and sports clubs dominant in the education of "Skill Defining-Development and Specialization" of children have an early success expectation, trainings not considering the "game and entertainment" concepts are seen.

Therefore, the children who are at the start of sports-related movements period and equipped with raw skills are categorized as "successful-unsuccessful, skilled-unskilled". In order to contribute to the right specialization of children at the right time, a general sportive training is offered in addition to team sports, individual sports and recreation sports regularly to children until their specialization ages who are accepted at the ages of 5-6 to (Bilge et al., 2010) the "Multi-Branches Talent Identification and Development Project" started in Turkey.

The branch skill tests are also included in the scope in addition to the anthropometric and physical tests that are performed periodically. As a result of the longitudinal study, branch proposals will be made by using objective data and it has been aimed that the children who started their branch trainings towards the age of 10 will be improved to the competitor level under the supervision of the concerned clubs and their coaches (Bilge et al., 2010; Bilge et al., 2014).

The primary purpose of this project is to enable the children to do physical activities specific to their own age group in the "play" format and as accompanied by experts and to ensure them to participate in the movement trainings voluntarily and effectively. Hence, it will be possible to integrate sports in the daily lives of individuals starting from early ages (Bilge et al., 2010; Bilge et al., 2014).

In this model, during the 3 training sessions of 90 minutes each per week, basic sports are practiced during the first 45-minute section (athletics, gymnastics, coordination and educational games by turns), and 4 team sports are practiced (basketball, soccer, handball and volleyball) during the second 45-minute section for one month by turns and 2 individual sports are practiced (racket sports and contact sports) by children at the ages of 5-6 who are accepted to the project without precondition. The experts prepare each training unit that is to be practiced in this project at the level of "prescription training".

The children's anthropometric measurements and motor performance values are archived at the tests that are to be performed periodically once every six months and by using these values;

a) Their developments in comparison to the previous measurements,
b) Their places within their own chronologic age group,
c) Their places within the international normative datas are designated and archived.

At the continuance of the four or five periodical measurements, objective and comprehensive individual data of the children are accessed who are subject to skill

defining tests for their branches periodically in order to guide them to especially the right branch when they reach the age of 10.

By this model, it is aimed to attain step-wise and multi-faceted development of children by the training programs focusing on "games and entertainment" which are their needs and by preventing their performance anxiety (Bilge et al., 2010; Bilge et al., 2014).

B. BP (The training based on especially basketball)

The second research group basketball sports school group was included in the study as an example of early privatization.

2.4. Procedure

All measurements were performed at an indoor sports hall.

TGMD-2 was administered by following standardized test procedure (Ulrich, 2000). The test was given and recorded by a video camera by reaching the groups at their location. The recorded data were observed in a computer setting and scored according to TGMD-2 criteria. The administration setting was arranged before starting the test to minimize the test administration time and remove distractions. All material necessary for the test were prepared. The children were asked to wear non-skid shoes to prevent slipping and falling during the test. Maximum effort and safety was achieved during the motor skill practice owing to this. The test duration changed according to the child's age and experience of the administrator. An extra 10 minutes was allowed for set up and cleaning. TGMD-2 was completed in a test session (Ulrich, 2000).

2.5. Data analyses

Besides descriptive statistics, Kruskal-Wallis test was performed to analyse the differences between groups in the development percentage of the locomotor, object control, and total scores. Development percentage was calculated between pre-test and post-test values.

We used Mann Whitney U-test for post hoc comparisons. In addition, Wilcoxon Signed Ranks test was conducted to determine differences among pre and post test scores of all three groups. Effect sizes were calculated to determine the effects of training prıogram. The magnitude of r were classified small, moderate and large.

3. Results

Table 2 shows Wilcoxon test results and mean scores of the locomotor subtest of the three groups. Wilcoxon test indicated that post-test locomotor scores of TGMD-2 were significantly higher than pre-test scores for all three groups ($p < .01$). All children developed in the locomotor skills during the six-month period.

Table 2: Wilcoxon test results and descriptive statistics for locomotor scores of all three groups

Locomotor scores								
Groups	**n**	**Pre-test**		**Posttest**		**z**	**p**	**r**
		M	**Sd**	**M**	**Sd**			
MB	54	16.20	2.73	17.48	2.61	-4.25	.001	0.58
BP	55	13.92	2.46	14.53	2.56	-4.34	.003	0.58
CG	50	12.18	2.58	13.24	2.47	-4.31	.001	0.60

Note. r : effect size

Similar with the results on locomotor scores, Wilcoxon test showed that post-test object control scores of TGMD-2 were significantly higher than pre-test scores for all three groups ($p < .01$). All children also improved their object control skills during the six-month period (Table 3).

Table 3: Wilcoxon test results and descriptive statistics for Object Control scores of all three groups

Object Control scores								
Groups	**n**	**Pre-test**		**Post-test**		**z**	**p**	**r**
		M	**Sd**	**M**	**Sd**			
MB	54	11.92	2.75	14.87	2.03	-6.06	.001	0.82
BP	55	13.56	3.00	14.49	2.58	-4.34	.001	0.58
CG	50	10.78	2.61	11.70	2.89	-4.99	.001	0.70

Notes. r : effect size

Considering the total scores of TGMD-2, Wilcoxon test detected statistically significant differences between pre-test and post-test total scores for all three groups in favour of post-test scores ($p < .01$). Inspection of the means reveals that there was an improvement in total scores of the children during the six-month period (Table 4).

Table 4: Wilcoxon test results and descriptive statistics for Total scores of all three groups

Total scores								
Groups	**n**	**Pre-test**		**Post-test**		**z**	**p**	**r**
		M	**Sd**	**M**	**Sd**			
MB	54	28.12	4.47	32.35	3.86	-4.51	.001	0.61
BP	55	27.49	4.45	29.01	4.24	-4.23	.001	0.57
CG	50	22.96	4.46	24.94	4.71	-5.67	.001	0.80

Notes. r : effect size

Kruskal Wallis test results indicated that there were statistically significant differences between three groups on the object control and total scores of TGMD-2 ($p<.01$) but no differences on the locomotor scores of the test (Table 5).

Table 5: Kruskal-Wallis test results and mean ranks for all skills of all three groups

Scores	MB Mean Rank	BP Mean Rank	CG Mean Rank	x^2	p	η^2
Locomotor	83.56	73.20	83.64	1.86	.394	0.01
Object Control	109.84	63.45	65.98	34.65	.001	0.22
Total	101.28	63.15	75.55	17.46	.001	0.11

Notes. η^2 : effect size

Post hoc comparisons by using Mann-Whitney U test indicated that MB group significantly differed from both BP and CG groups in the object control and total scores of TGMD-2 ($p < .01$), while BP and CG groups did not differ from each other. The development percentage of MB group in these scores was significantly higher than those of the other two groups.

4. Discussion

This study intended to examine the development of gross motor skills among children aged 6-8 years old after six-month training program based on LTAD perspective.

The results of TGMD-2 test performed before and after the six-month training program between the two research groups and control group included in the "Multy Branches Talent Identification and Development Project" aiming longitudinal development of athletes, and the developmental differences were investigated. Based on the results, it was revealed that there was a significant difference between the first measurement and the second measurement in L. Considering the L score averages, there was development in the locomotor skills of the children during six months ($p<0.01$).

A significant difference was revealed between the first measurement and the second measurement in OC in each of the three groups. Considering the OC score averages, there was development in the object control skills of the children during six months ($p<0.01$).

A significant difference was revealed between the first measurement and the second measurement in total skill scores in each of the three groups. Considering total skill score averages, there was development in total skills of the children during six months ($p<0.01$).

It was found following the binary comparisons that the difference between the object control developmental percentages stemmed from the first research group MB. Considering the object control development percentages, there was more development in the scores of MB group.

It was found again following the binary comparisons that the difference between total score developmental percentages stemmed from the first research group MB. Considering total score development percentages, there was more development in the scores of MB group.

There are numerous studies which applied TGMD-2 test in the literature.

Boz and Aytar (2012) studied the effect of the implemented basic movement education program on the movement skills of 120 pre-school children in the 5-6 age-group, who received the basic education program for 2 days a week for 30 minutes, and found that the effect of their development in TGMD-2 test scores on fundamental movement skills (loco motor and object control) was higher as statistically significant in comparison to the children who attended a daily pre-school program.

Valentini and Rudisill (2000) conducted a research to study whether the girls and boys having a low performance differed in terms of motor skills by implementing a 12-week motivating education program for the first group in the 5-6 age-group (experiment group) and TGMD-2 application, and in the children in the second group (control group) who attended no education program, and the effect of motivating education practice on these children; it was found that the final test scores of the loco motor and object control skills in the experiment group were higher than those of the control group as statistically significant.

Tepeli (2013) studied the relationship between the gross muscle motor skills and visual perception of 54-59 month-old pre-school children who were applied TGMD-2 and FGGAT (Frostig Visual Perception Development Test) in his research, and reported a statistically significant high relationship between TGMD-2 sub-test and total scores of the children and FGGAT sub-test and total test scores.

Tsapakidou et al. (2014) assessed the loco motor development of 3.5-5 year-age group pre-school children whose motor development level measurement was carried out in two stages as pre-program and after program by following a 2-month fundamental movement education program in the experiment group and by program follow up in the control group in their research, and there was no statistically significant difference found between the two groups before the program implementation, and there was a statistically significant difference between the two groups in the second measurement, and in addition, the performance values in the experiment group were higher as statistically significant since the assessment of the main values.

5. Conclusion

In conclusion, considering whether there was a difference between the two measurements made in a six-month interval for each group in the study, the test results revealed that there was a statistically significant difference between the first measurement and the second measurement in L, OC and total scores in each of the three groups. Considering L, OC and total score averages, it was seen that the children developed during the six-month training process.

Despite the statistically significant difference seen in each of the three groups, considering the difference seen between the groups, the result was not significant.

Considering whether there was a difference in developmental percentages between the two measurements made with a six-month interval for each group, it was

seen that OC and total score results were higher than those of BP and CG groups in favor of MB group and statistically significant.

The object control and total skill scores of the MB group improved because especially excessive number of sports equipment were used in the multi-branch project (different ball types, hoops, cones, targets, headpins, sponges, various mats, various rackets, etc.). Therefore, hand-eye coordination of the children improved better and their object control skill scores increased.

Kerkez (2013) conducted a research to study the basic motor skills of 10 year-old children who participated in the individual, pair and team sports competitions by using the TGMD-2 test. As a result of this study, it was shown that there were not significant differences between the TGMD-II locomotor subtest scores of the children who played individual, pair and team sports (F2, 119; 1.479; P>0.246), and there were significant differences between the TGMD-II object control subtest scores of the children who played individual, pair and team sports (F2, 119; 7.935; P<0.001), and there were significant differences between the total TGMD-II scores of the children who played individual, pair and team sports (F2, 119; 7.141; P<0.001), and there were significant differences between the TGMD-II locomotor subtest scores of the children depending on the sports branch (F5,119; 8.058; P<0.001), and there were significant differences between the TGMD-II scores of the children depending on the sports branch (F5,119; 7.037; P<0.001), and there were significant differences between the total TGMD-II scores of the children depending on the sports branch (F5,119; 9.722; P<0.001).

Acknowledgements

This article also has no financial support, technical assistance, and intellectual contributions not associated with authorship. The present study has been produced from master thesis of first author.

Conflict of interest

The authors have no conflicts of interest to declare.

Disclosure

There are no financial or other conflicts of interest associated with this work.

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